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Mapping the in situ microscale distribution of microphytobenthic biomass in coastal sediments: a hyperspectral methodology

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Microphytobenthic primary production is the fundament of the trophic food web in coastal marine sediments. The concentration of photopigments, which are a proxy for phototrophic biomass, in the surface sediment is considered as a basic environmental descriptor in benthic studies. The mechanisms that control the distribution of benthic microalgae are complex, ranging from physico-chemical drivers (e.g. tidal action, nutrient availability) to ecological drivers (e.g. grazing). Here we present a novel, field-deployable hyperspectral imaging system that allows non-invasive in situ mapping of the photosynthetic microalgal biomass distribution with a high spatial (<1mm) and temporal (minutes) resolution.

Using this system, we found a remarkably heterogeneous and dynamic distribution of microalgae in surficial intertidal sediments. These distributions were tightly linked to sediment surface topography (e.g. ripples) and to the distribution and activity of benthic infauna. We hypothesize that this correlation is facilitated by the influence of these factors on the advective transport of porewater and the associated fluxes of dissolved nutrients across the sediment-water interface. We argue that the utility of the high-resolution hyperspectral imaging method overcomes the inadequate resolution of traditional methods based on sedimentary chlorophyll extraction, and significantly improves our understanding of the processes that control benthic productivity in coastal sediments.